Empowered by Innovation NEC

NEC Storage Software

NEC Storage PathManager User's Manual (VMware version)

IS206-04E

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Preface

This document illustrates how to use NEC Storage PathManager.

NEC Storage PathManager multiplexes paths between a server and a storage unit in a system with Express5800 and the NEC Storage Disk Array SubSystem.

Remarks

1. Functions described in this document are supported by the following software:

   NEC Storage PathManager 1.2 for VMware

2. The following descriptions in this text refer to the corresponding products unless otherwise stated.

Description	Corresponding Product
PathManager	NEC Storage PathManager for VMware
vCLI	vSphere Command-Line Interface
ESMPRO	ESMPRO/ServerAgent

3. In this document, matters to which careful attention needs to be paid will be described as follows:

   Be sure to observe the contents.

   If the indications are ignored and the system is improperly operated, settings which have been already made might be affected.

Type of Indication	
Type	Description
	Describes contents which require special attention during operation.

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The 4th Edition in July 2014

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Part I Overview

Chapter 1 Overview of NEC Storage PathManager

This chapter will provide basic information such as an overview, hardware configuration, and software configuration of PathManager. This chapter will also illustrate features of the software.

1.1 Overview of NEC Storage PathManager

This section will illustrate the features of PathManager.

PathManager is a software which allows multi-path connection between a server and a NEC Stroage disk array subsystem. Using PathManager, the following features are available:

- Path failover when a failure occurred on a path
- Load balancing using multiple paths

1.1.1 Handling Path Failures

PathMananger can handle with faliures occurred in a HBA, a network interface card, a controller of a storage unit, a FC-cable, a FC-fabric , a SAS-cable or a LAN cable (on iSCSI connection) using redundant paths.

When a failure occurs in a path and a storage unit can no longer be accessed during system operation, PathManager will detect the event. PathManager then switches the path to be used from the failed path to a normal path so that access to the storage unit can continue. No I/O will be lost during the course of switching the paths. Applications can continue their processing without being aware of the path failure.

Additionally, when PathManager detects a path failure intermittently, PathManager closes the path to avoid the I/O performance degration caused by the intermettent failure.

1.1.2 Load Balancing Function

PathManager has a load balancing function that uses redundant paths to distribute loads.

Using this function will improve the access efficiency of NEC Storage.

1.2 Configuration of NEC Storage PathManager

This section will describe the configuration of Pathmanager.

PathManager operates on physical servers such as Express5800 and monitors the paths connected by FC cables or SAS cables between the HBA (host bus adapter) or the NIC (network interface card) at the server and the HP (host port) of NEC Storage.

PathManager consists of the modules shown as "Figure 1-1 Configuration of PathManager" below;

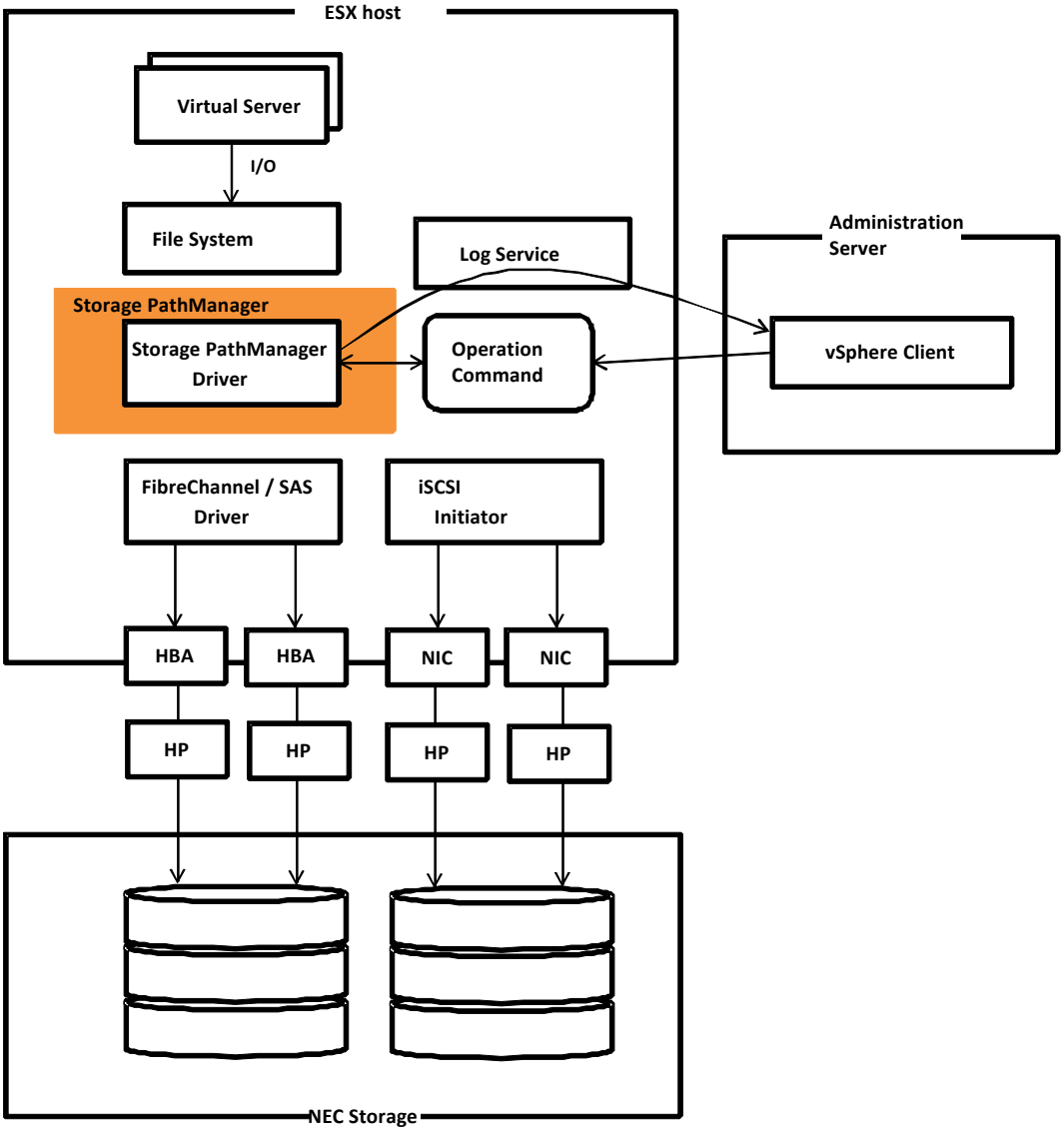

Figure 1-1 Configuration of PathManager

NEC Storage PathManager driver controls basic functions of PathManager such as redundant paths and load

balancing.

1.3 System Configuration

This section will show the basic configuration examples of a system to which PathManager is installed .

1.3.1 Single-server Configuration

In this configuration, a server and NEC Storage are directly connected. The system is relatively small, and the configuration is the most common. An example of configuration is shown as "Figure 1-2. Single Server Configuration" below;

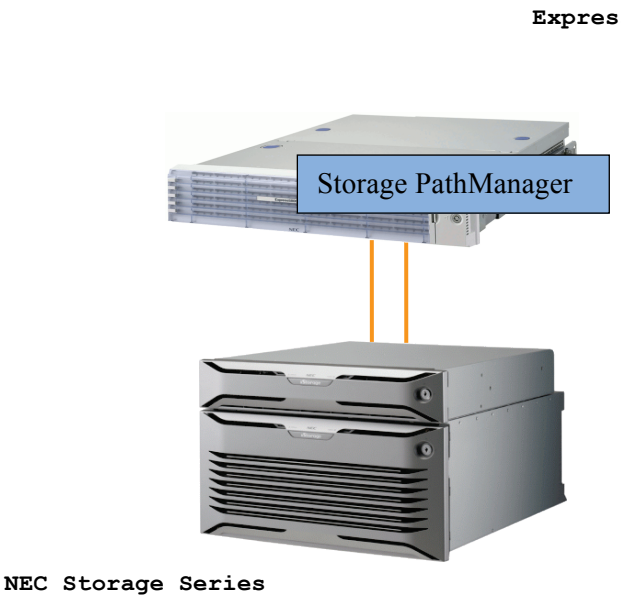

Figure 1-2 Single-server Configuration

1.3.2 Multiple-server Configuration

In this system, multiple servers are directly connected to NEC Storage. This system configuration is used when multiple servers having different tasks share a relatively large NEC Storage. Exclusive control such as access control is necessary among logical units used by respective servers.

An example of the configuration is shonw as "Figure 1-3. Multiple-Server Configuration" below;

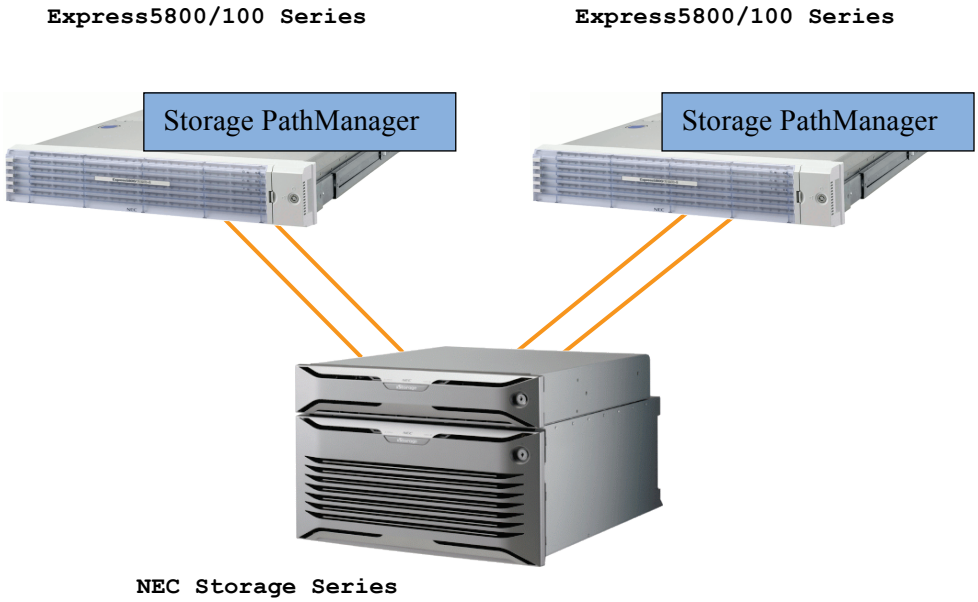

Figure 1-3 Multiple-server Configuration

Part II Installation

Chapter 2 Installing NEC Storage PathManager

This chapter will describe about an operating environment and setup procedures required to use PathManager.

2.1 Operating Environment

Operating environment for PathManager is shown from as below. In addition to the ESX host, an administration server is needed to manage the ESX host by VMware vSphere Client and so on to use PathManager.

Table 2-1: System requirements

	NEC Storage PathManager for VMware
Operating systems	ESX host server: VMware ESXi 5.0 VMware ESXi 5.1 VMware ESXi 5.5 Note: PathManager supports all updates in each ESXi. Administration server: The OS supported with VMware vSphere Client and vSphere Command-Line Interface
Server	ESX host server: Express5800/100 Series Rack Servers Express5800/100 Series Tower Servers Express5800 Enterprise Servers Administration server: A server supported with VMware vSphere Client and vSphere Command-Line Interface
Memory	ESX host server: Memory required by OS + 20 MB or more Administration server: Follow the requirements with VMware vSphere Client and vSphere Command-Line Interface
Disk capacity	ESX host server: Total capacity of programs :1MB Capacity required to use PathManager: 5MB or more Administration server: Follow the requirements with VMware vSphere Client and vSphere Command-Line Interface
Connection protocols	FC / iSCSI / SAS Note: PathManager does not support SAS in ESXi5.5.
HBA/initiator	FC/SAS-HBAs or NICs (Network Interface Cards) supported by the server and NEC storage
NEC Storage	M5000 series (PathManager supports ESXi 5.5 or later.) M700 series M500 series M300 series M100 series M10 series

Other required software	VMware vSphere Client VMware Command-Line Interface (The above software programs are installed to the administration server. The versions of the software programs depend on that of ESX.) The cooperation with the following software is available. (optional) - ESMPRO (V4.5 or later) - SigmaSystemCenter (V3.3 or later)

The following figure shows where to install PathManager and the other required software programs.

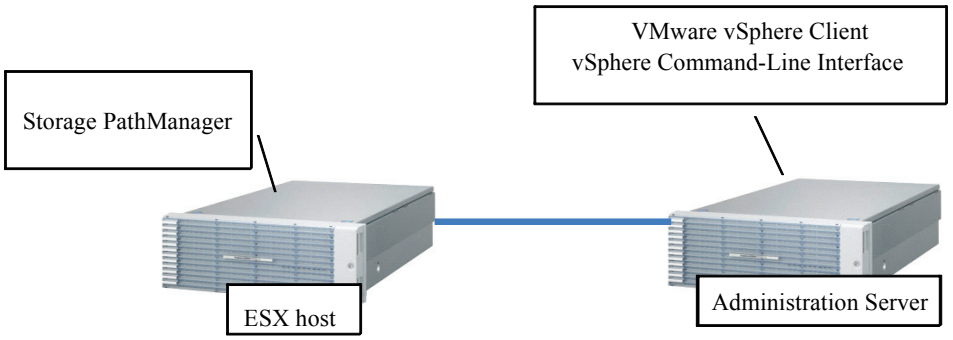

Figure 2-1.The ESX Host and the Administration Server

2.2 Notices to Use

This section explains notices to use PathManager.

2.2.1 Limitation for Number of Paths and Logical Disks

Table 2-6 shows limitation for number of paths and logical disks.

Table 2-3: Limitation for number of paths and logical disks.

	NEC Storage M Series (FC)	NEC Storage M Series (iSCSI)	NEC Storage M Series (SAS)
Maximum number of paths per logical disk.	32 paths	8 paths	2 paths
Maximum number of logical disks.	256 disks	256 disks	256 disks
Maximum number of logical paths (*1)	1024 paths	1024 paths	512 paths

(*1) Total number of paths for all logical disks.

2.2.2 Available Load Balancing for Storage Units

PathManager works as SATP (Storage Array Type plug-in) of ESX. When an I/O error is detected, SATP will change the status of the path and switch to another path for I/O. The load balancing function is implemented by the built-in PSP (Path Selection Plug-in) with ESX. PathManager supports the VMW_PSP_MRU(Most Recently Used) and VMW_PSP_RR(Round Robin).

2.3 Setup

The Setup CD is used to `setup` PathManager. The Setup CD allows the following actions:

/1/ Installation

It installs PathManager to the server

/2/ Version upgrade

It upgrades PathManager in the server from the older version.

/3/ Uninstallation

It completely removes PathManager from the server.

For further details about installation and non interactive installation, refer to the "Installation Guide."

The following sections describe procedures of version upgrade and uninstallation.

2.3.1 Version upgrade

Use the Setup CD and execute the following procedures to upgrade PathManager.

If you use the Windows version of vCLI, move the \bin folder of vCLI (C\Program Files\VMware\VMware vSphere CLI\bin as default), and then execute the commands.

1. **[Administration server]** Upload (CD media drive):
   NEC-nec_satp_sps-<aaaaaa>-offline_bundle-<bbbbbb>.zip to the datastore of the ESX host which will be installed PathManager using VMware vSphere Client (Datastore Browser) or ssh.

   StoragePathSavior
   + "esx55" or "esx50_esx51" (Choose according to the target OS.)
   + NEC-nec_satp_sps-<aaaaaa>-offline_bundle-<bbbbbb>.zip

2. **[ESX host or Administration server]** Execute the following command. (The following example is inserted line feeds for convenience, but you must execute the command in one line.)

   For ESX Shell or SSH

```
# esxcli software vib install -d "/vmfs/volumes/datastore1/NEC-
nec_satp_sps-<aaaaaa>-offline_bundle-<bbbbbb>.zip"
```

For vCLI (In this case, specify root as the username, and enter the root password of the ESX host.)

```
# esxcli --server <IP address or host name of ESX host> software
 vib install -d  "/vmfs/volumes/datastore1/NEC-nec_satp_sps-
<aaaaaa>-offline_bundle-<bbbbbb>.zip"
```

3. **[ESX host or Administration server]** Confirm the following message is displayed when the version upgrade is finished. (It may take some minutes to install).

```
Installation Result
   Message: The update completed successfully, but the system needs to
be rebooted for the changes to be effective.
   Reboot Required: true
   VIBs Installed: NEC_bootbank_nec_satp_sps_<Ver>-<version/
revision of PathManager>
   VIBs Removed: NEC_bootbank_nec_satp_sps_<xxx.x.x>-<version/
revision of PathManager>
   VIBs Skipped:
```

Note: If OS is VMware ESXi5.0 or ESXi5.1, <Ver> is "500.1.1".

If OS is VMware ESXi5.5, <Ver> is "550.1.2".

<xxx.x.x> is the previous version of PathManager.

Confirm that "The update completed successfully, but the system needs to be rebooted for the changes to be effective." is displayed in the Message line.

If the above message is not displayed or the other content is shown in Message line, please confirm the following things;

- The filename that you entered is correct.
- [vCLI] ESX host and Administration server are connected with IP network and can communicate with each other.
- [vCLI] The versions of ESX, VMware vSphere Client and vCLI are supported with PathManager.

4. **[ESX host or Administration server]** Reboot the ESX host which is installed PathManager from the console or VMware vSphere Client

5. **[ESX host or Administration server]** Execute the following command and confirm that

PathManager is installed correctly.

For ESX Shell or SSH

```
# esxcli software vib list | grep nec_satp_sps
nec_satp_sps      <Ver>-yyyyyy-xxxx     NEC      VMwareAccepted
yyyy-mm-dd
```

For vCLI

```
# esxcli --server software vib list
nec_satp_sps      <Ver>-yyyyyy-xxxx     NEC      VMwareAccepted
yyyy-mm-dd
```

The version upgrade of PathManager is now complete.

2.3.2 Uninstallation

Use the following procedures to uninstall PathManager.

1. Execute the following command.

For ESX Shell or SSH

```
# esxcli storage nmp satp rule remove --satp NEC_SATP_SPS --vendor NEC
--boot
```

For vCLI

```
# esxcli --server <host name or IP address> storage nmp satp rule remove
--satp NEC_SATP_SPS --vendor NEC --boot
```

2. Then, execute the following command.

For ESX Shell or SSH

```
# esxcli storage nmp satp rule list
```

For vCLI

```
# esxcli --server <host name or IP address> storage nmp satp rule list
```

Please confirm that NEC_SATP_SPS is not shown in the plug-in list.

3. And then, execute the following command in vCLI, and confirm the output message.

For ESX Shell or SSH

```
# esxcli software vib remove -n nec_satp_sps
```

For vCLI

```
# esxcli --server <host name or IP address> software vib remove -n
nec_satp_sps
```

Confirm that "Operation finished successfully" is displayed in the Message line.

```
Removal Result
   Message: The update completed successfully, but the system needs to
be rebooted for the changes to be effective.
   Reboot Required: true
   VIBs Installed:
   VIBs Removed: NEC_bootbank_nec_satp_sps_<Ver>-xxxxxxx
   VIBs Skipped:
```

4. Reboot the ESX host which is uninstalled PathManager from the console or VMware vSphere Client.

5. Execute the following command and confirm that PathManager is uninstalled correctly.

For ESX Shell or SSH

```
# esxcli software vib list | grep nec_satp_sps
```

For vCLI

```
# esxcli --server <IP address or host name> software vib list
```

Confirm that the module name "nec_satp_sps" is not displayed.

If you used ESMPRO reporting function with Linux syslog server and do not need any more, stop the syslog forwarding.

The uninstallation of PathManager is now complete.

Part III Functions

Chapter 3 Functions of NEC Storage PathManager

This chapter describes functions that PathManager offers. Basic functions of PathManager can be roughly categorized as follows:

/1/ Path state display

This function displays information regarding state of paths.

/2/ Load balancing

This function distributes I/O loads to multiple paths.

/3/ Handling with path failures

This function disables failed paths and failovers to alternative paths when a path failure occurs, and failbacks at the time of recovery from a failure.

/4/ Path patrol

This function monitors the state of paths. It also detects failures and recovery from failures as they occur.

/5/ Log extraction and alerts

This function outputs operation information and failure information to system log files and dedicated log files as operation histories. This function also issues notifications to VMware vSphere Client and/or SigmaSystemCenter as failure information is outputted.

If using Linux syslog server and ESMPRO Linux Edition, events of PathManager are also notified via ESMPRO in ESXi5.5.

3.1 Path State Display

This section will describe the path state display function of PathManager.

3.1.1 Path State

You can confirm the path state from VMware vSphere Client.

On the administration server, execute VMware vSphere Client and log into the target ESX host.

For the details with VMware vSphere Client, please refer to the manuals of VMware vSphere Client. This document explains about the important or PathManager specified operations.

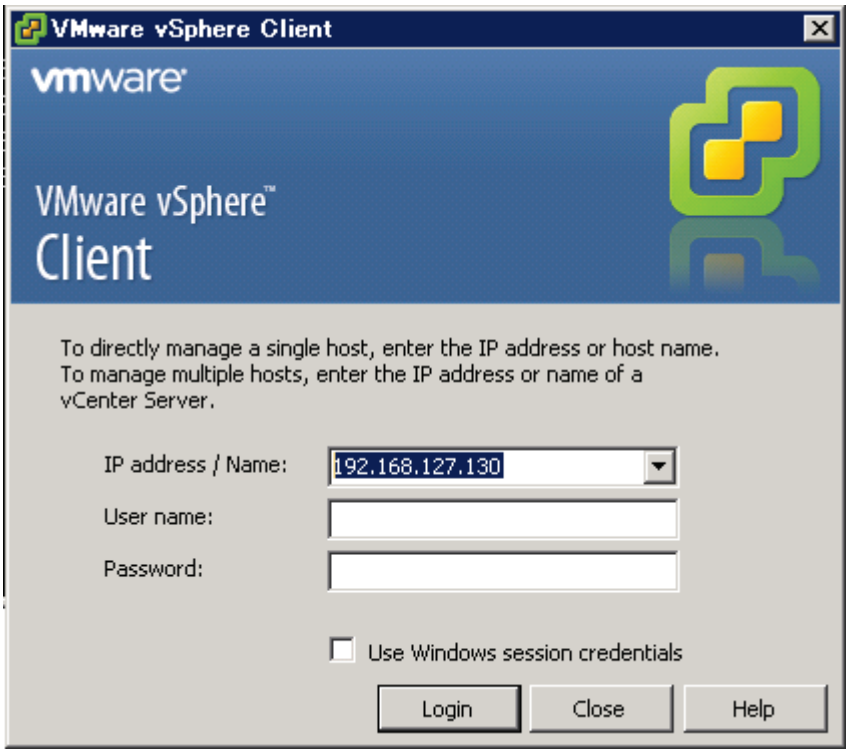

Figure 3-1. VMware vSphere Client log-in window

When you log into the ESX host or vCenter Server, VMware vSphere Client windows will be appeared. Select the target host from the left pain, and select "Configuration" tab. Then, if you select "Storage Adapters" from the "Hardware" list, the list of the storage adapters installed in the ESX host will be displayed.

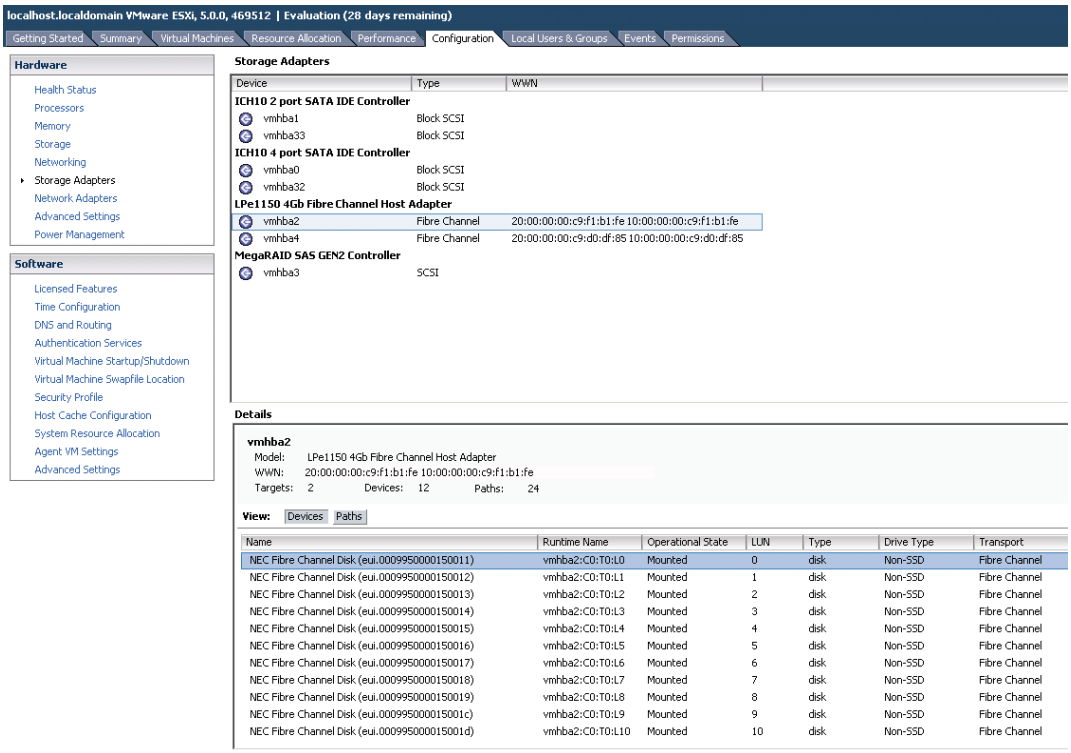
localhost.localdomain VMware ESXi, 5.0.0, 469512 | Evaluation (28 days remaining)
Getting Started
Summary
Virtual Machines
Resource Allocation
Performance
Configuration
Local Users & Groups
Events
Permissions
Hardware
Health Status
Processors
Memory
Storage
Networking
Storage Adapters
Network Adapters
Advanced Settings
Power Management
Software
Licensed Features
Time Configuration
DNS and Routing
Authentication Services
Virtual Machine Startup/Shutdown
Virtual Machine Swapfile Location
Security Profile
Host Cache Configuration
System Resource Allocation
Agent VM Settings
Advanced Settings
Storage Adapters
Device
Type
WWN
ICH10 2 port SATA IDE Controller
vmhba1 Block SCSI
vmhba33 Block SCSI
ICH10 4 port SATA IDE Controller
vmhba0 Block SCSI
vmhba32 Block SCSI
LPe1150 4Gb Fibre Channel Host Adapter
vmhba2 Fibre Channel 20:00:00:00:c9:f1:b1:fe 10:00:00:00:c9:f1:b1:fe
vmhba4 Fibre Channel 20:00:00:00:c9:d0:df:85 10:00:00:00:c9:d0:df:85
MegaRAID SAS GEN2 Controller
vmhba3 SCSI
Details
vmhba2
Model: LPe1150 4Gb Fibre Channel Host Adapter
WWN: 20:00:00:00:c9:f1:b1:fe 10:00:00:00:c9:f1:b1:fe
Targets: 2 Devices: 12 Paths: 24
View: Devices Paths
Name
Runtime Name
Operational State
LUN
Type
Drive Type
Transport
NEC Fibre Channel Disk (eui.0009950000150011) vmhba2:C0:T0:L0 Mounted 0 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150012) vmhba2:C0:T0:L1 Mounted 1 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150013) vmhba2:C0:T0:L2 Mounted 2 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150014) vmhba2:C0:T0:L3 Mounted 3 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150015) vmhba2:C0:T0:L4 Mounted 4 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150016) vmhba2:C0:T0:L5 Mounted 5 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150017) vmhba2:C0:T0:L6 Mounted 6 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150018) vmhba2:C0:T0:L7 Mounted 7 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.0009950000150019) vmhba2:C0:T0:L8 Mounted 8 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.000995000015001c) vmhba2:C0:T0:L9 Mounted 9 disk Non-SSD Fibre Channel
NEC Fibre Channel Disk (eui.000995000015001d) vmhba2:C0:T0:L10 Mounted 10 disk Non-SSD Fibre Channel

Figure 3-2. VMware vSphere Client configuration window

If you select the adapter connected with NEC storage form the storage adapter list, the list of logical disks assigned with the adapter will be displayed in the "Details" box.

Adapters which is not connected with NEC Storage may also be displayed in the storage adapter list.

After that, right-click on the specified logical disk, and select "Manage Paths", then Manage Paths window will be appeared.

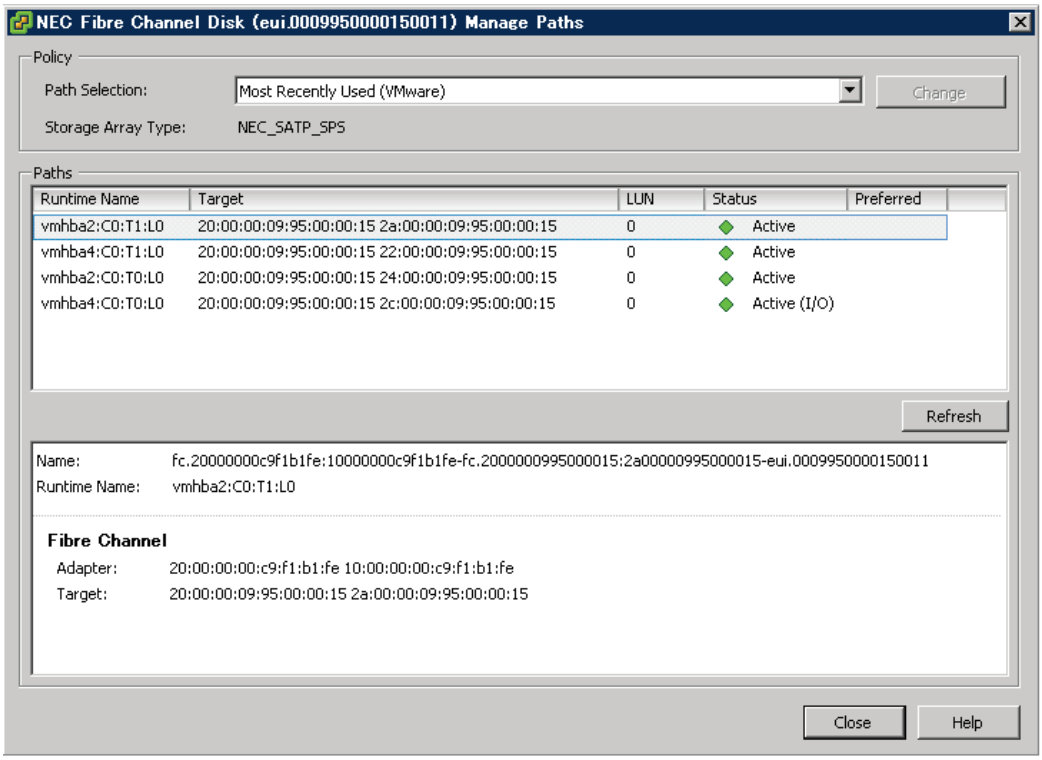

Figure 3-3. VMware vSphere Client Manage Paths window

If the specified logical disk is managed by PathManager, "NEC_SATP_SPS" is displayed in "Storage Array Type", and "Path Selection" is "Most Recently Used (VMware)" or "Round Robin (VMware)".

PathManager does not support the path selection types other than "Most Recently Used (VMware)" or "Round Robin (VMware)". Please do not change the "Path Selection" from "Most Recently Used (VMware)" or "Round Robin (VMware)".

The pass state can be confirmed by esxcli command of the VMware standard. Please refer to "vSphere 5 Command Line Documentation"(http://pubs.vmware.com/vsphere-50/index.jsp) about how to use the esxcli command.

Ex) The path state by the esxcli command is displayed like as follows:

```
# esxcli storage nmp path list
fc.20000000c9a11c85:10000000c9a11c85-fc.2000000991000803:2b00000991000803-eui.00099100080310
71
   Runtime Name: vmhba6:C0:T2:L84
   Device: eui.0009910008031071
   Device Display Name: NEC Fibre Channel Disk (eui.0009910008031071)
   Group State: active optimized
   Array Priority: 0
   Storage Array Type Path Config: {TPG_id=1,port=2,TPG_state=AO,pref=0,primary,(NEC DISK
ARRAY[FC])}
   Path Selection Policy Path Config: {non-current path; rank: 0}

fc.20000000c9a11c85:10000000c9a11c85-fc.2000000991000803:2b01000991000803-eui.00099100080310
96
   Runtime Name: vmhba6:C0:T3:L121
   Device: eui.0009910008031096
   Device Display Name: NEC Fibre Channel Disk (eui.0009910008031096)
   Group State: active unoptimized
   Array Priority: 0
   Storage Array Type Path Config: {TPG_id=3,port=2,TPG_state=ANO,pref=0,non-primary,(NEC DISK
ARRAY[FC])}
   Path Selection Policy Path Config: {non-current path; rank: 0}
```

The "primary"/"non-primary" information (shown in red above) is used to judge whether the path provides the optimized performance or not. The controller attribute can be determined by the combination with the Group State and the primary/non-primary information as the following table.

Controller Attribute	Group State	primary/non-primary
Current owner	active optimized	primary
Primary Controller	active unoptimized	primary
Non-primary Controller	- (Any group states)	non-primary

3.2 Load Balancing Policies

This section will describe the load balancing function of PathManager. This function distributes I/O loads to available paths managed by PathManager.

PathManager does the loadbalancing using PSP, and the supported PSPs by PathManager are VMW_PSP_MRU (Most Recently used (VMware)) and VMW_PSP_RR(Round Robin). Please do not use the other PSPs for the logical disk managed by PathManager.

The Recommended load balancing policy is "Round Robin". But, please use "Most Recently used" in the following case.

- When MSCS (Microsoft Cluster Service) or WSFC (Microsoft Failover Cluster) is used in guest OS earlier version than ESXi5.5.

q.v.

http://kb.vmware.com/selfservice/search.do?cmd=displayKC&docType=kc&docTypeID=DT_KB_1_1&externalId=2052238

As PathManager issues I/Os to the preferred controller assigned by the disk array for each disk pool, PathManager balances and reduces the load on the entire disk array. To work the load balancing function properly, the disk pools and logical disks in NEC Storage must be configured appropriately.

Most Recently used(MRU)In the case of "Most Recently used"(VMW_PSP_MRU), VMW_PSP_MRU determines the path for this I/O with the following priority.

/1/ The path specified by the storage array

NEC Storage assigns the controller which should be used preferentially (preferred controller) for each disk pool. VMW_PSP_MRU uses a path connected with the preferred controller as a top priority.

/2/ The path used for the most recent I/O request

If there are two or more paths or no paths connected with the preferred controller, VMW_PSP_MRU uses the path used for the most recent I/O request.

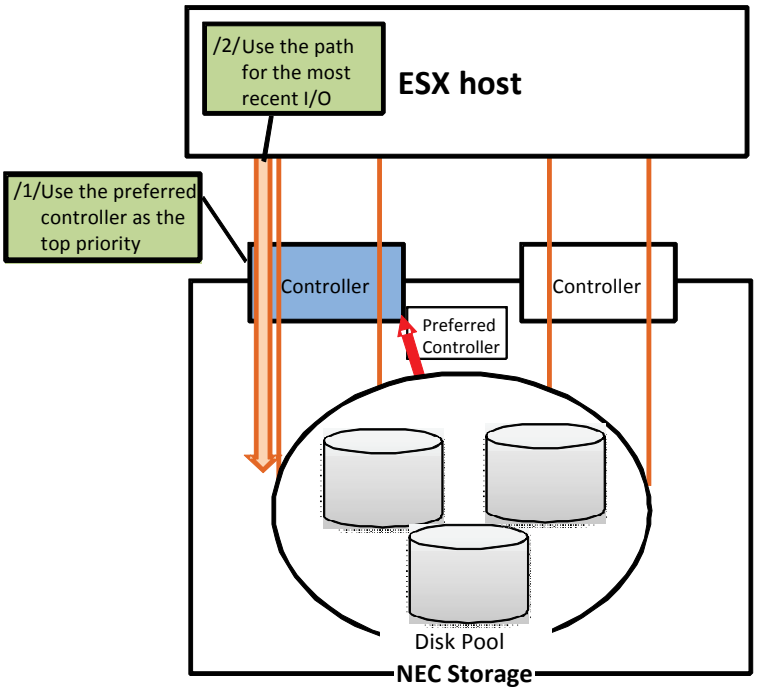

Figure 3-4. How to determine a path for I/O with VMW_PSP_MRU

3.2.1 Round Robin

In the case of "Round Robin" (VMW_PSP_RR), all the recognized paths are always used to each I/O request. VMW_PSP_RR chooses paths in descending order of priority. When a lowest priority path was used, VMW_PSP_RR uses a highest priority path again.

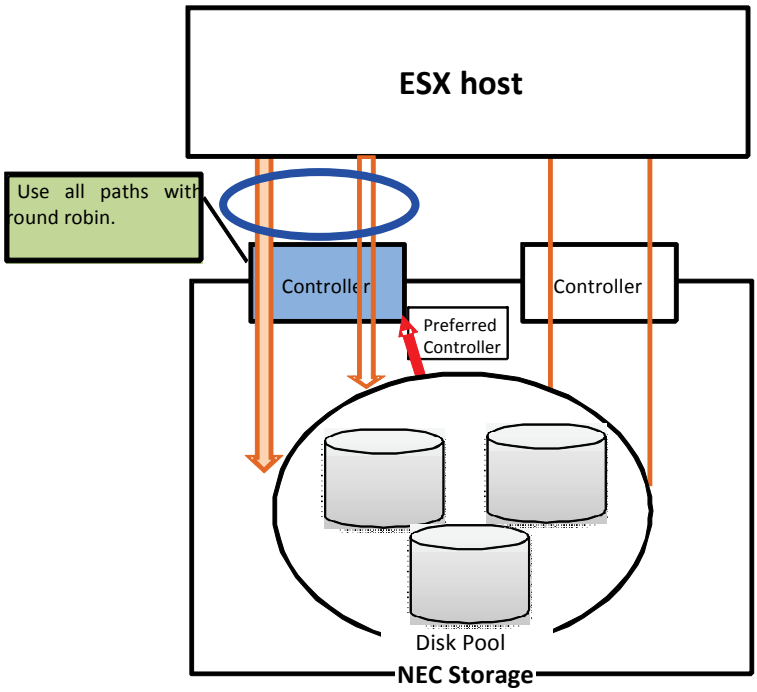

Figure 3-5. How to determine a path for I/O with VMW_PSP_RR

3.3 Handling with Path Failures

This section will describe the functions to handles with path faliures by PathManager. These functions will be used when a path failure or a path recovery has been occurred,

3.3.1 Failover

When failures occur in the paths, NEC Storage PathManager automatically switches paths to be used from failed paths to normal paths. This action is referred to as failover. The transition of the path state is shown in Figure 3-6.

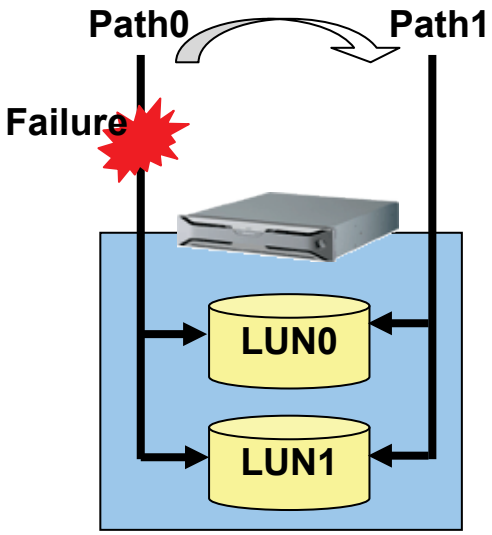

Figure 3- 6 Failover

Transition of path status on failover is shown in Figure 3-7.

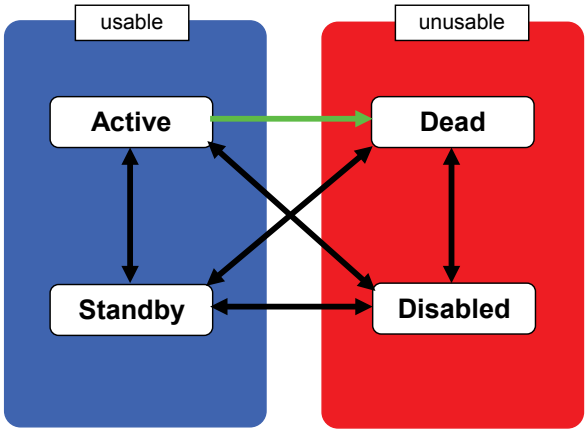

Figure 3- 7 Transition of path status on failover

* Each state name is shown with VMware vSphere Client.

Furthermore, when path state becomes "Dead" due to a failover, PathManager alerts an event to VMware vSphere Client.

PathManager executes a failover after an error was returned from a storage unit, a HBA or a NIC. Therefore, if a failure such those devices could not respond and return any errors to PathManager has been occurred, it may take several minutes to failover. (The required time depends on the timeout process of OS.)

3.3.2 Failback

When unusable paths due to failures recover from the failures and become available again, NEC Storage PathManager automatically recognizes this event and adds these recovered paths to the group of usable paths. This action is referred to as failback. The transition of path state is shown in Figure 3-8.

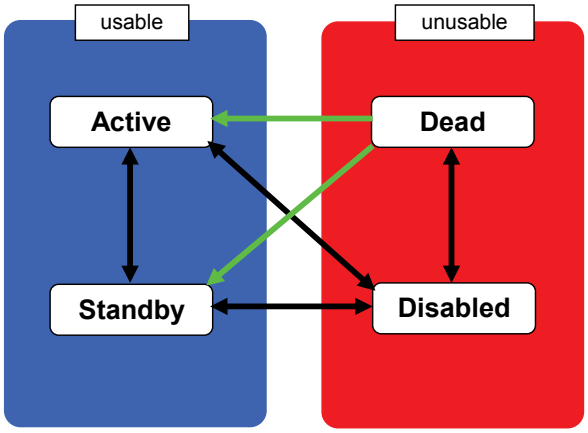

Figure 3- 8 Transition of path status

There are two types of failback, auto failback and manual failback with PathManager.

(1) Auto Failback

PathManager monitors a path every five minutes (refer to "3.4 Path Patrol"). If PathManager detects a path is recovered on path patrol, failback occurs and the state of the recovered path changes to "Active".

Other than the path patrol, if PathManager detects a path is recovered, auto failback is executed.

(2) Manual Failback

If you want to recover a path without waiting path patrol every five minutes or recover a path of which the auto failback is disabled caused by the intermittent failure (refer to "3.3.3 Intermittent failure detection"), you can recover a path by the following procedures;

/1/ Log into the console of the target host.

/2/ Execute the following in the command line.

```
~ # esxcli storage nmp satp generic pathconfig set -c "failback" -p <runtime name
   of the path>
```

With –p option, specify the runtime name of the path to failback.

You can also use vCLI to failback a path with the following procedures;

/1/ Execute vCLI.

/2/ Execute the following in the command line.

```
~ # esxcli --server=<host name or IP address> storage nmp satp generic pathconfig
set -c "failback" -p <runtime name of the path>
```

Specify the target ESX host name or IP address and runtime name of a path to failback with --server and –p options, respectively.

3.3.3 Monitoring Intermittent Failure

Usually, when path falure occures, the I/O requests to the path will be returned with error constantly.

However, in case that hardware is unstable and is not completedly failed, the I/O requests may be returned with error not constantly but intermittently. This type of failure is called intermittent failure.

Because the errors are not reported constantly, PathManager may continue to use the unstable paths or repeat to failover and failback over and over again. As a result, I/O throughput from applications may be degraded.

To prevent a degradaing of throughput in such case, PathManager have a feature to close a path before doing a failover when an intermittent failure is detected. The path closed by this feature cannnot be failed back automatically.

If you want to recover the path closed by intermittent failure, fix the hardware failure, and then do failback manually using esxcli (refer to "3.3.2 Failback").

The intermittent failure detection feature cannot be disabled.

You can confirm the paths of which automatically failback is disabled from a path information command of esxcli on the console of ESX host or vCLI (you cannot confirm this information from VMware vSphere Client).

Here is an execution example on the console.

```
~ # esxcli storage nmp path list
  :
  :
fc.20000000c981ab9b:10000000c981ab9b-fc.2000000995000020:2100000995000020-eu
i.0009950000200018
   Runtime Name: vmhba2:C0:T0:L4
   Device: eui.0009950000200018
   Device Display Name: NEC Fibre Channel Disk (eui.0009950000200018)
   Group State: active unoptimized
   Array Priority: 0
   Storage Array Type Path Config: {TPG_id=1,port=3,TPG_state=ANO,pref=0,(NEC
DISK ARRAY[FC]) (MFB-only)}
   Path Selection Policy Path Config: {non-current path; rank: 0}
```

"MFB-only" (Manual Failback only) in red letters on the above figure is displayed with the path of which automatically failback is disabled.

PathManager prevents I/O throughput from degrading by two ways of monitoring operations as follows;

(1) Monitoring errors on static state

PathManager always observes errors on all paths. The target errors are two types as follows;

- I/O request errors
- Health check errors (refer to "3.6.1 Health Check")

If PathManager detects these errors three times in 20 minutes on a path, the path is closed and shift to "Dead" state. After that, this path is not used for I/O request (Figure 3-9).

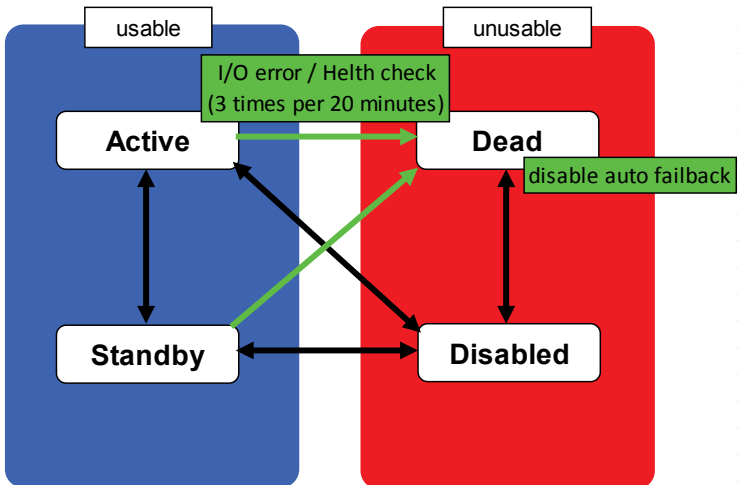

Figure 3-9 Monitoring errors on static state

(2) Monitoring errors just after recovering from failure

When a path is failed back from a dead state, the path becomes active and PathManager monitors such path.

After five minutes from failed back without a failover again, PathManager stops monitoring the path.

If the failover and shifting to the dead state occurred three times on the path during the monitoring, PathManager regards such path as having an intermittent failure and stops automatically failback.

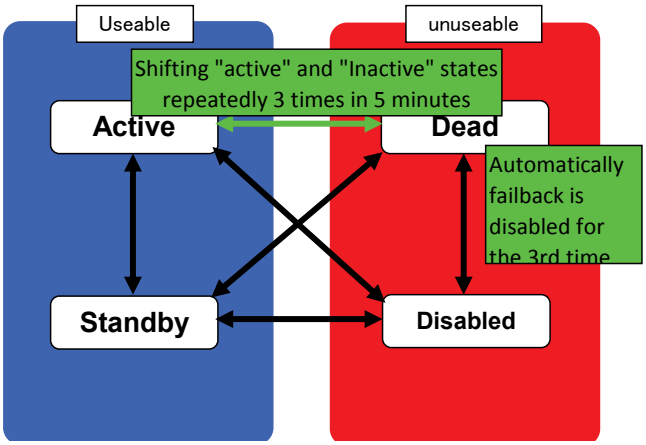

Figure 3-10 Intermittent failure caused by failover and failback repeatedly

You can confirm the monitored path from a path information command of esxcli on the console of ESX host or vCLI (you cannot confirm this information from VMware vSphere Client).

Here is an execution example on the console.

```
~ # esxcli storage nmp path list
  :
  :
fc.20000000c981ab9b:10000000c981ab9b-fc.2000000995000020:2100000995000020-eu
i.0009950000200018
   Runtime Name: vmhba2:C0:T0:L4
   Device: eui.0009950000200018
   Device Display Name: NEC Fibre Channel Disk (eui.0009950000200018)
   Group State: active unoptimized
   Array Priority: 0
   Storage Array Type Path Config: {TPG_id=1,port=3,TPG_state=ANO,pref=0,(NEC
DISK ARRAY[FC]) (Monitoring)}
   Path Selection Policy Path Config: {non-current path; rank: 0}
```

"Monitoring "in red letters on the above figure is displayed with the monitored path.

3.4 Path Patrol

This section will describe the path patrol function in PathManager. This function realize the following two features to monitor the state of all paths periodically.

- Health check

This feature monitors the active paths. If a failure occurs on a path, the state of the path is changed to "dead". (In this case, an event is reported to VMware vSphere Client.)

- Recovery check

This feature confirms the dead paths. If recovery check finds a dead path is recovered, PathManager fails back such path automatically.

Path patrol feature issues the monitoring I/O every five minutes, and changes the path state depending on its result.

You cannot disable path patrol feature, and you cannot change the interval of path patrol.

3.4.1 Health Check

Health check feature issues the monitoring I/O to the active paths and detects/closes the failed paths. When health check feature closes a path, the behavior of this feature is as follows;

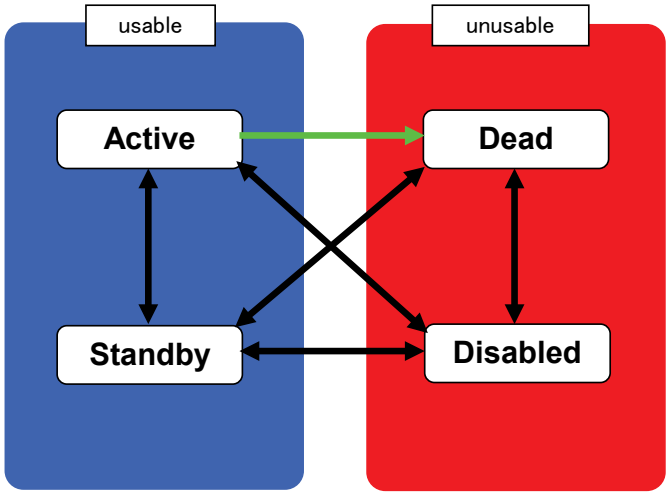

Figure 3-11 Closing a path by health check

3.4.2 Recovery Check

Recovery check feature automatically fails back a path that is recovered from a failure by issuing the monitoring I/O to dead paths. When a path is failed back by the recovery check, the transition of path state is shown in Figure 3-12.

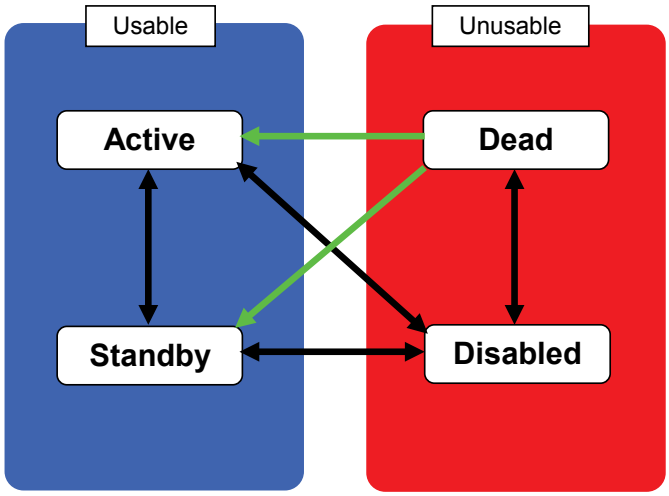

Figure 3- 12 Failback by recovery check

3.5 Alerts

PathManager reports important events via vSphare Client. PathManager does not require any setting for this reporting function.

If using SigmaSystemCenter, events of PathManager are also notified via SigmaSystemCenter. When using ESXi5.5 (PathManager 1.2.0 or later), it is possible to forward the event of PathManager to ESMPRO on the Linux syslog server.

When you use SigmaSystemCenter with this version of PathManager, please use SigmaSystemCenter V3.3 or later. Please refer to a manual of SigmaSystemCenter about details of SigmaSystemCenter. When you use ESMPRO with this version of PathManager, please use ESMPRO Linux edition V4.5 or later.

The output format of the syslog message was changed since PathManager Ver1.2.0. The [message ID] is added before a message body. [message ID] is a character string of 8 digits of hexadecimal and is the unique value among the PathManager outputs.

PathManager Ver 1.1.x or earlier:

NEC_SATP_SPS: "message"

PathManager Ver 1.2.0 or later:

NEC_SATP_SPS: [message ID] "message"

The events of PathManager alerts are as follows;

(A message is an example of PathManager Version 1.2.0 or later.)

3.5.1 Non-redundant configuration

Description of the alert:

NEC_SATP_SPS: [C00000001] xxx is not redundant.

(Where xxx is device (logical disk) name.)

Meaning:

Configuration of logical disk xxxx is not redundant.

Handling:

Confirm if one of the following conditions is met.

(1) There are no path of which conditions are "Disabled" in VMware vSphere Client.

➔ Change the state of all "disabled" paths to "active" using VMware vSphere Client.

(2) The ESX host and the storage unit are connected via only one port of HBA/NIC on ESX host.

➔ Change a connection configuration to use two or more ports on the ESX host.

(3) The ESX host and the storage unit are connected via only one controller on the storage unit.

➔ Change a connection configuration to use two or more controllers on the storage unit.

(4) FC switch or ethernet switch is turning off.

➔ Turn on the all switches in the connection configuration.

(5) All the LED indicates link up of HBAs/NICs, switches, and storage ports are not lighting.

➔ Confirm if there are any failures on port and hardware, cables are connected definitely to ports, and connectors are not solied.

(6) One of the storage controller is failed (confirming from LED of disk array or Storage Manager).

➔ Recover from the failure following the maintenance procedures of disk array.

(7) One of the HBA or NIC is failed (confirming kernel log of ESX host).

➔ Recover from the failure following the maintenance procedures of hardware.

(8) One of the FC switch or ethernet switch is failed.

➔ Recover from the failure following the maintenance procedures of hardware.

(9) Logical or physical disk of disk array is failed (confirming with LED of the disk array or Storage Manager).

➔ Exchange the failed physical disk and so on following the maintenance procedure of hardware.

If you confirmed that there are no problems with the above things or resolved the applied problems, please do the following procedures.

(i) Confirm the connection configuration is redundant correctly (refer to "4.1.2 Confirm the Operation Condition" for the details).

(ii) If the connection configuration is not recovered with step (1), confirm if there are any paths in "dead" state. If any, please wait more than five minutes (until path patrol has been done) or execute a failback to the dead path from esxcli. Then, back to step (i).

(iii) If the configuration is not recovered with step (ii), execute the device rescan from console of ESX host or vCLI, and back to step (i). The command format of the console is as follows;

```
~ # esxcfg-rescan -A
```

(iv) If the configuration is not recovered with step (iii), confirm if there are any paths closed by intermittent failure. Please refer to "3.3.3 Intermittent Failure Monitoring" for details. If there are any paths closed by intermittent failure, do the manual failback using esxcli (see "3.3.2 Failback"). And then back to step (i).

(v) If the configuration is still not recovered with step (iv), reboot the ESX host and back to step (i).

This event is reported when configuration monitoring is executed. The first configuration monitoring is executed 30 minutes after the boot of ESX host, and the subsequent monitoring is done every 24 hours. Please confirm the same event is not reported with configuration monitoring after the problems are resolved.

3.5.2 Path failure

Description of the alert:

NEC_SATP_SPS: [C00000002] Path state moved to DEAD from yyy on zzz (xxx)

or

NEC_SATP_SPS: [C00000003] Path state moved to UNAVAILABLE from yyy on zzz (xxx)

(Where xxx, yyy and zzz are device name, arbitrarity state name and runtime name of the path, respectively.)

Meaning:

A failure occurred on path zzz and PathManager closed the path.

Handling:

Confirm if one of the following conditions is met.

(1) All the LED indicates link up of HBAs/NICs, switches, and storage ports are not lighting.

➔ Confirm if there are any failures on port and hardware, cables are connected definitely to ports, and connectors are not solied.

(2) One of the storage controller is failed (confirming from LED of disk array or Storage Manager).

➔ Recover from the failure following the maintenance procedures of disk array.

(3) One of the HBA or NIC is failed (confirming kernel log of ESX host).

➔ Recover from the failure following the maintenance procedures of hardware.

(4) One of the FC switch or ethernet switch is failed.

➔ Recover from the failure following the maintenance procedures of hardware.

(5) Logical or physical disk of disk array is failed (confirming with LED of the disk array or Storage Manager).

➔ Exchange the failed physical disk and so on following the maintenance procedure of hardware.

If you confirmed that there are no problems with the above things or resolved the applied problems, please do the following procedures.

(i) Confirm the path becomes "active" or "active (I/O)" state (refer to "4.1.2 Confirm the Operation Condition" for the details).

(ii) If the connection configuration is not recovered with step (i), confirm if there are any paths in "dead" state. If any, please wait more than five minutes (until path patrol has been done) or execute a failback to the dead path from esxcli. Then, back to step (i).

(iii) If the configuration is not recovered with step (ii), execute the device rescan from console of ESX host or vCLI, and back to step (i). The command format of the console is as follows;

```
~ # esxcfg-rescan -A
```

(iv) If the configuration is not recovered with step (iii), confirm if there are any paths closed by intermittent failure. Please refer to "3.3.3 Intermittent Failure Monitoring" for details. If there are any paths closed by intermittent failure, do the manual failback using esxcli (see "3.3.2 Failback"). And then back to step (i).

3.5.3 Losing logical disk

Description of the alert:

NEC_SATP_SPS: [C00000004] Path state moved to PERM_LOSS from yyy on zzz (xxx)

(Where xxx, yyy and zzz are device name, arbitrarity state name and runtime name of the path, respectively.)

Meaning:

PathManager detected logical disk xxx is lost from the storage unit.

Handling:

This event is generally reported only when a user intended to remove a logical disk from a disk array.

Thus, please confirm whether this event came from the removal of a logical disk or not with maintenance history and so on. If the cause is the logical disk removal, there is nothing to deal with this event.

If the cause is not logical disk removal, please confirm if one of the following condition is met with the path.

(1) Logical or physical disk of disk array is failed (confirming with LED of the disk array or Storage Manager).

➔ Exchange the failed physical disk and so on following the maintenance procedure of hardware.

(2) One of the storage controller is failed (confirming from LED of disk array or Storage Manager).

➔ Recover from the failure following the maintenance procedures of disk array.

If you confirmed that there are no problems with the above things or resolved the applied problems, please do the following procedures.

(i) Confirm the path becomes "active" or "active (I/O)" state (refer to "4.1.2 Confirm the Operation Condition" for the details).

(ii) If the state is not recovered with step (1), execute the device rescan from console of ESX host or vCLI, and back to step (1). The command format of the console is as follows;

```
~ # esxcfg-rescan -A
```

3.5.4 Closing a path by an Intermittent Failure

Description of the alert:

NEC_SATP_SPS: [C00000005] Path (xxx) cannot be failbacked automatically.

(Where xxx is a runtime name of the path.)

Meaning:

PathManager detected an intermittent failure and closed a path xxx.

Handling:

Confirm if one of the following condition is met with the closed path.

(1) The connection with HBA/NIC, switches and port of the disk array have not be done.

➔ Confirm if cables are connected definitely to ports, and connectors are not solied.

(2) One of the storage controller is failed (confirming from LED of disk array or Storage Manager).

➔ Recover from the failure following the maintenance procedures of disk array.

(3) One of the HBA or NIC is failed (confirming kernel log of ESX host).

➔ Recover from the failure following the maintenance procedures of hardware.

(4) One of the FC switch or ethernet switch is failed.

➔ Recover from the failure following the maintenance procedures of hardware.

(5) Logical or physical disk of disk array is failed (confirming with LED of the disk array or Storage Manager).

➔ Exchange the failed physical disk and so on following the maintenance procedure of hardware.

If you confirmed that there are no problems with the above things or resolved the applied problems, please do the following procedures.

(i) Execute the failback to the closed path by esxcli. Then, confirm the path becomes "active" or "active (I/O)" state (refer to "4.1.2 Confirm the Operation Condition" for the details).

(ii) If the state is not recovered with step (1), execute the device rescan from console of ESX host or vCLI, and back to step (1). The command format of the console is as follows;

```
~ # esxcfg-rescan -A
```

3.5.5 Alert events by ESX

ESX itself alerts the following events about a path failure and a path redundancy.

Table 3-1 Alert event by ESX

Description	Operation
Path redundancy to storage device xxx degraded. Path yyy is down. (Where xxx and yyy are a device name (logical disk name) and runtime name of the path, respectively.)	Refer to VMware KB: article ID=1009554.
Lost path redundancy to storage device xxx. Path yyy is down. (Where xxx and yyy are a device name (logical disk name) and runtime name of the path, respectively.)	Refer to VMware KB: article ID=1009555.
Path redundancy to storage device xxx (Datastores: zzz) restored. Path yyy is active again. (Where xxx, yyy and zzz are a device name (logical disk name), runtime name of the path and datastore name, respectively.)	Refer to VMware KB: article ID=1020456.
Lost connectivity to storage device xxx. Path yyy is down.	Refer to VMware KB: article ID=1009553.

(Where xxx and yyy are a device name (logical disk name) and runtime name of the path, respectively.)	
Connectivity to storage device xxx (Datastores: zzz) restored. Path yyy is active again. (Where xxx, yyy and zzz are a device name (logical disk name), runtime name of the path and datastore name, respectively.)	Refer to VMware KB: article ID=1020379.

* For the details of VMware KB, please refer to the following;

http://kb.vmware.com/selfservice/microsites/microsite.do

3.5.6 Alert Events by E-mail

If you want to receive the alerts in the previous section by e-mail and so on, install vCenter Server to the administartion server. When the PathManager event occurs, the default alarm “Host error” is notified to vCenter Server.

For details, please refer to the vCenter Server Documentation (http://pubs.vmware.com/vsphere-50/index.jsp?topic=/com.vmware.vsphere.doc_50/GUID-553E2EBD-6D19-4873-98FD-265B3A92F1F0.html).

The example of settings is available in "VMware vSphere Example and Scenarios" -> "Alerm Example: Setting an Alerm Action for Datastorage Usage on a Disk".

3.5.7 syslog Liaison

Using ESMPRO reporting function and Linux syslog server, PathManager can report the important events reported in syslog. A syslog server is needed for each ESXi servers. This function is supported in ESXi5.5 or later and PathManager 1.2 or later.

When you use ESMPRO with this version of PathManager, please use ESMPRO Linux edition V4.5 or later. Please refer to a manual of ESMRPO about detail.

Following setting is required in the syslog server and ESXi host.

Setting in the ESXi host

(1) Disable a firewall to a syslog server.

Following command image is when using a direct console or SSH. When using vCLI, please add an IP address or host name" as "--server <ESX host>" next to "esxcli".

i. Check the current setting

```
# esxcli network firewall ruleset list | grep syslog
       syslog                false
```

ii. Disable a firewall

```
# esxcli network firewall ruleset set --ruleset-id=syslog --enabled=true
```

iii. Check the new setting

```
# esxcli network firewall ruleset list | grep syslog
         syslog                true
```

(2) Set the syslog forwarding

i. Check the default setting

```
# esxcli system syslog config get
```

ii. Set the setting of syslog forwarding by UDP

```
# esxcli system syslog config set --loghost="udp://<IP address of syslog server>"
```

iii. Check the new setting

```
# esxcli system syslog config get
       Remote Host: udp:<IP address of syslog sever>
```

iv. Reload syslog syslog service

```
# esxcli system syslog reload
```

Setting in the syslog server

Note: "root" permission is needed for this operation.

(1) Install the alert table of ESMPRO/ServerAgent (Linux Edition).

i. Copy "StoragePathSavior/esx55/AlertTable" directory to the Linux syslog server.

ii. Change the current directory to the copied "StoragePathSavior/esx55/AlertTable" directory.

iii. Use "sh setup_alert_vm.sh" shell script with the language option.

[Use-case of English alert table setting]

```
# sh setup_alert_vm.sh -e
```

[Use-case of Japanese alert table setting]

```
# sh setup_alert_vm.sh -j
```

iv. Check the message

When the following message was shown, the setting is correct.

```
Setting of the alert table is successful.
```

When the following message was shown, installation is not complete. Please check the install option.

```
setup_alert_vm.sh version 1.0.0 - Copyright (C) 2013-2014 NEC Corporation.
usage: setup_alert_vm.sh [LANGUAGE]
LANGUAGE
        -j : Japanese
        -e : English
ex )    setup_alert_vm.sh -j
```

(2) Set the syslog daemon setting

i. Set "-r" to "SYSLOGD_OPTIONS" in "/etc/sysconfig/syslog"

Ex) Sample setting of RedHat Enterprise Linux 5.9

Before change: SYSLOGD_OPTIONS="-m 0"

After change: SYSLOGD_OPTIONS="-m 0 -r"

ii. Restarts syslogd

```
# /sbin/service syslog restart
```

(3) Set syslog-ng

Three event reports occur for one event occurrence, because PathManager records the event to 3 logfiles of VMware. When you use the following setting, PathManager makes one report by one event occurrence. Note: This rule will also be applied to the event which is not reported by PathManager. So, this setting is optional.

i. Install syslog-ng

Note: A libnet library is needed to use syslog-ng.

ii. Add below setting to /etc/syslog-ng/syslog-ng.conf.

```
source s_vmsps {
         udp(ip(0.0.0.0) port(514));
};
filter f_vmsps { match('^vmkernel:'); };

log { source(s_vmsps); filter(f_vmsps); destination(d_mesg); };
```

iii. Restart syslog-ng.

```
# /sbin/service syslog-ng restart
```

(4) Set ESMPRO

i. Use ESMamsadm command

```
# /opt/nec/esmpro_sa/bin/ESMamsadm
```

ii. Set alert target

Append the IP address of the PC in which an alert viewer is installed with the GUI.

For details, please see a manual of ESMPRO.

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Part IV Operation

Chapter 4 Operating NEC Storage PathManager

This chapter will describe the things needed such as checking the operation status and handling of troubles when PathManager is in operation.

4.1 Operation in Normal State

This section will show the things such that you must do at the beginning of the operations and how to check the operation status when PathManager is normally in operations.

4.1.1 Starting Operation

From then on, PathManager automatically starts up when the system starts up, and PathManager automatiocally groups paths for each logical unit and conceals the paths in applications (to make only one path visible). PathManager automatically stops when the system stops.

PathManager for VMware is running on the multi-path workframe of VMware and you can confirm the path state and manage paths by VMware vSphere Cilent and vCLI. For the details of VMware vSphere Cilent and vCLI, please refer to the documentation of these products.

4.1.2 Checking Operation Status

After installing PathManager and before starting its operation, make sure that multiple paths connect the server and NEC Storage and that PathManager is properly functioning.

This section describes how to check this by VMware vSphere Client.

(1) Execute VMware vSphere Client, and log into the host PathManager is installed.

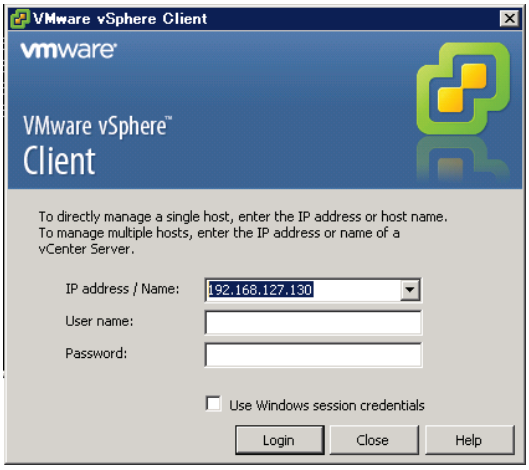


Figure 4-1. Log on window of VMware vSphere Client

(2) After the log on, select the storage adapter from the "Hardware" list, and click a "Configuration" tab.

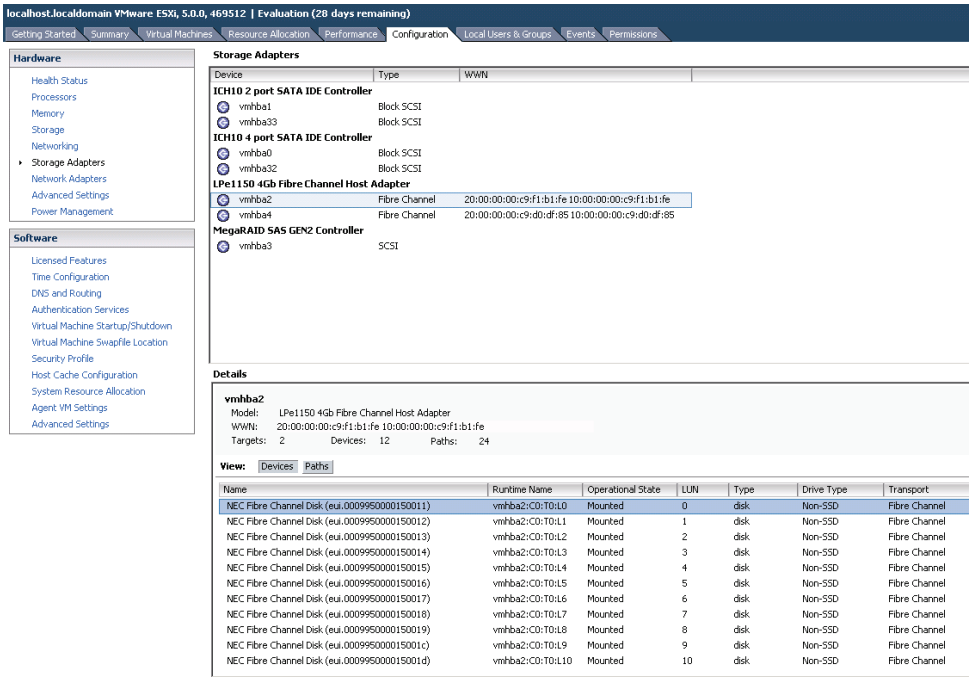


Figure 4-2 "Configuration" windows of VMware vSphere Client

(3) Confirm if there are two or more storage adapters in the Storage Adapters list. Figure 4-2 is an example that ESX host and disk array are connected via 4Gb fibre channel HBA, and the adapters connected to the disk array are shown in "xxx (arbitrated letters) 4Gb Fibre Channel Host Adapter".

(4) If an adapter is selected, the list of disks that can be accessed from the adapter in the "Details" box and you can confirm the target disk array. If you use NEC Storage, "NEC xxx (depending on the connection protocol) Disk" is shown in "Name" column.

(5) When you push "Paths" button in the "Details" box, the states of access paths from the specified adapter to each logical disk are displayed. Confirm all paths to the disk array is normal by checking this information for each adapter.

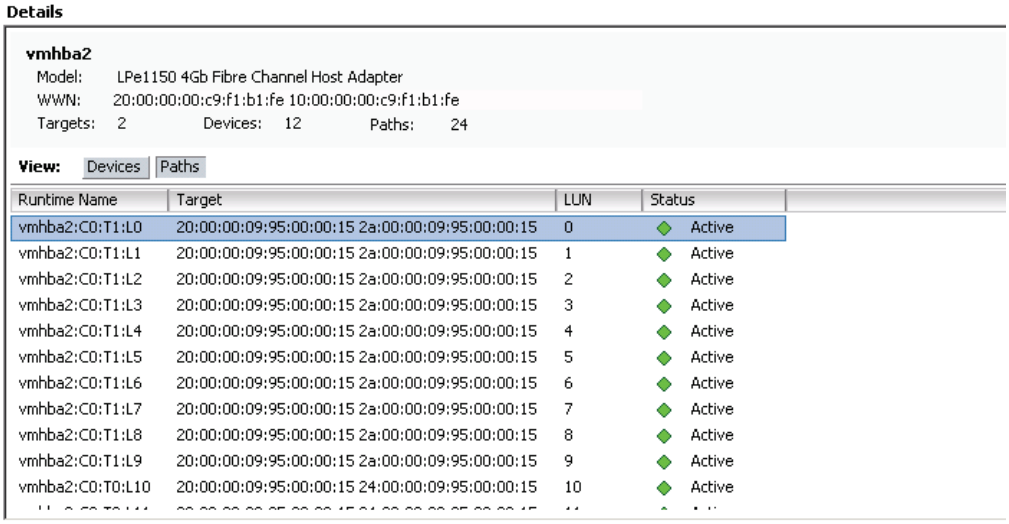


Figure 4-3. Checking the path states

(6) You can also confirm the number and states of paths for each logical units. Show "Device" in "Details" box, and right click on one of the disk line, and then select "Manage Paths".

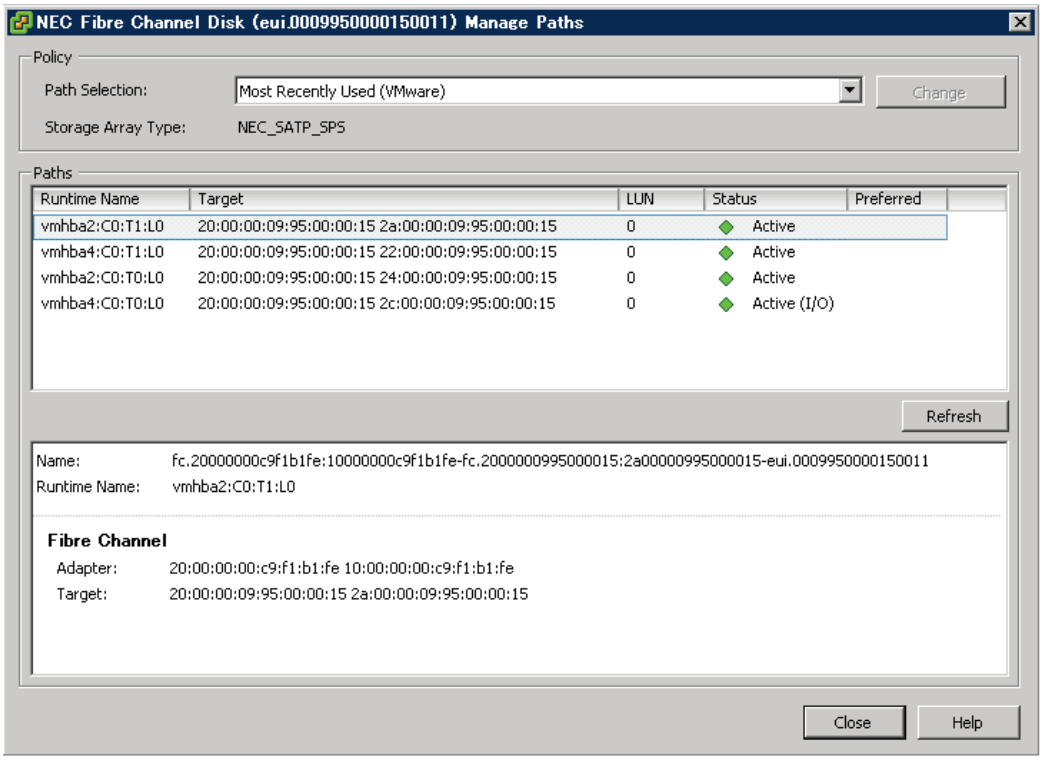


Figure 4-4 Manage Paths windows of the VMware vSphere Client

If the expected number of paths is not displayed or path information is not appeared, please refer to "4.2.1 FAQs and Troubleshooting" and check if any cases in this section are applied before making inquiries.

4.2 Handling Abnormalities

This section will describe the things need to confirm when a trouble is occurred and the information need to make inquiry as a troubleshooting when PathManager is in operation.

How to deal with when a failure is occurred, please also refer to "3.5 Alerts".

4.2.1 FAQs and Troubleshooting

When a trouble is occurred as PathManager is in operation, the things need to confirm before making inquiries is described in "Table 4-1 FAQs and Troubleshooting".

Table 4-1 FAQs and Troubleshooting

Inquiry (event)	Points to check	Handling
The number of paths shown in esxcli and VMware vSphere Client is only one or is not as expected.	Is NEC Storage connected with the server correctly?	Confirm the connection between NEC Storage and the server
	Are NEC Storage and FC fabrics turned on?	Confirm NEC Storage and FC fabrics are turned on.
	Is the configuration of Access Control of NEC Storage correctly set?	Confirm the configuration of Access Control of NEC Storage. Confirm also the server and NEC Storage connected logically.
	Is the configuration of zoning of the FC fabric correctly set?	Confirm the configuration of zoning of the FC fabric.
	If you use the iSCSI connections, you must configure the iSCSI Initiator. Can you access to the NEC Storage from the server?	Confirm whether the setting of iSCSI Initiator is correct. Confirm whether ping command to the IP addresses of the port of NEC Storage successes.
NEC_SATP_SPS event is registered in VMware vSphere Client	Does the hardware work correctly?	Refer to "3.5 Alerts" and deal with the hardware problem.

4.2.2 Information Gathering Necessary in Case of Failures

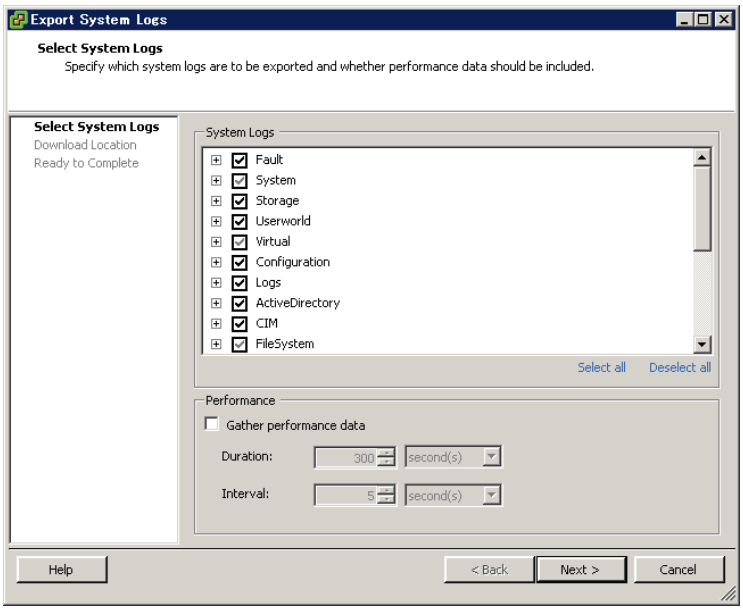
When path failures occur or when some kind of trouble occurs in PathManager, collect the basic information such as date of failure, details of failure, and system configuration that is necessary when investigating the failure.

If information is collected only in part or if no information is collected, causes of failure may not be identified since sufficient investigation cannot be carried out.

Collect the following information that is necessary in investigation from the viewpoint of PathManager by VMware vSphere Client and ESX host.

1. Execute VMware vSphere Client and log into the ESX host to collect the log files.
2. Click "Export" -> "Export System Log" from the "File" menu.

3. Export System Logs dialog box is displayed.



4. Open the items in "System Logs" box, and confirm if the following items are checked. (If you do not change the settings after the setup, the condition of the check boxes is as follows).

Do not check to "Collect Performance Data". If this item is checked, real-time performance information is collected, and this may cause not to finish taking the required information or may take much time to finish

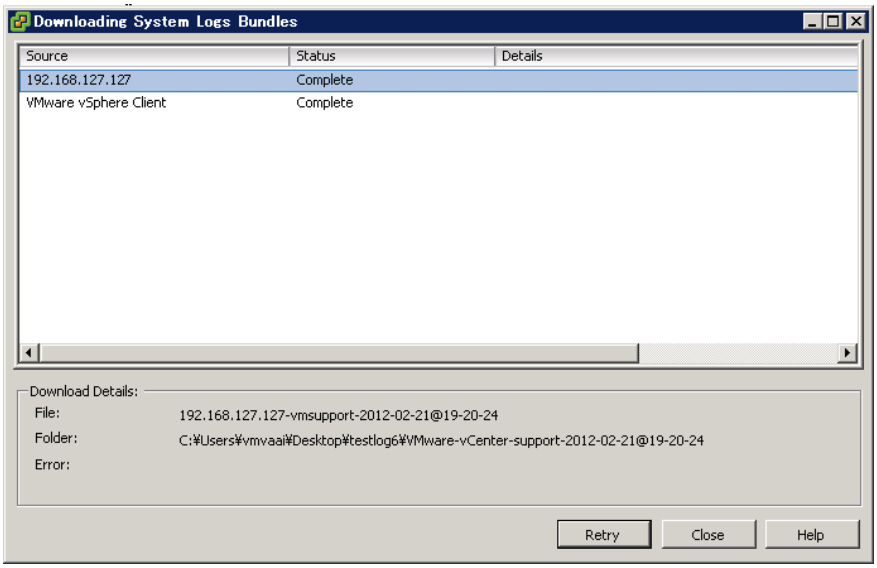
- Fault -> all itmes
- System -> Base, EsxImage, Modules, Resource, VMKernel, VMKernel_Cores
- Storage -> all items
- Userworld -> all items
- Virtual -> Virtual, Base, core, disk, logs
- Configuration -> all items
- Logs -> all items
- ActiveDirectory -> all items
- CIM -> all items
- FileSystem -> base
- Hardware -> all items
- Installer -> all items
- Network -> all items

- hostProfiles -> all items
- IntegrityChecks -> all items
- Testing -> no items
- Crash -> all items
- PerformanceSnapshot -> no items

5. Click "Next". Download location is confirmed, specify the location and click "Next".

6. Confirmation window is appeared, click "Finish". After that log collection is started.

7. "Downloading System Logs Bundles" windows appears. When the log collection is finished, the statuses of the target host and VMware vSphere Client are "Complete".



8. Collect the logs from the specified download location.

9. In addition to the logs, collect all files in the following directory:
   /scratch/log/

Additionally, collect and send the version information of PathManager by executing following command.

If you execute from the console of ESX host, the command is as below;

```
~ # esxcli software vib list | grep nec_satp_sps
nec_satp_sps                   500.1.1-xxxxxx.yyyy                        NEC
PartnerSupported      20yy-mm-dd
```

The information in the second column ("5.00.1.1-xxxxx.yyyy" in the above) is the version of PathManager.

If you execute from vCLI, the command is as below;

```
> esxcli --server=(ESX host name or IP address) software vib list
```

In this case, the list of all installed package is displayed. Find the item of nec_satp_sps, and collect the second column of the information.

The collection of log files is now complete.

4.2.3 Operations Needed before a Hardware Maintenance

If you perform the maintenance on the storage controller online, you must switch a path not to issue I/Os via the path connected with the target controller using the maintenance tool prevent_hd.pl. This tool is running on vCLI. Execute vCLI and enter the following command;

On FC or SAS connection:

```
> prevent_hd.pl -w (WWPN of storage port) -e (IP address of ESX host)
```

Specify the WWPN of the port on the target controller in "WWPN of storage port". You can specify multiple WWPNs separated by a comma ",".

Specify the IP address of ESX host connected by the disk array in "IP address of ESX host". You also can specify multiple disk arrays separated by a comma. Specify all the ESX hosts connected by the disk array.

On iSCSI connection:

```
> prevent_hd.pl -i (IP address of storage port) -e (IP address of ESX host)
```

Specify the IP address of the port on the target controller in "IP address of the storage port". You can specify multiple addresses separated by a comma ",".

When the hardware maintenance finished, execute the following command to restore the I/O paths as before the maintenance.

```
> prevent_hd.pl -r -e (IP address of ESX host)
```

For the details of prevent_hd.pl, please refer to the README.txt in the \tool folder in the setup CD.

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Appendix

Appendix A esxcli Extension

PathManager extends the esxcli command partially to execute failback and rollback.

The following extended command is enabled only with devices and paths managed by PathManager. You cannot execute the extended command to the devices or paths that are not managed by PathManager.

For the details of the general command line tools such as esxcli, please refer to "vSphere 5 Command Documentation" in the documentation of vSphere 5 (http://pubs.vmware.com/vsphere-50/index.jsp).

(1) Failback Command

Failback the specified path manually. In the consol of ESX host, execute as follows;

```
~ # esxcli storage nmp satp generic pathconfig set -p (runtime name of a path) -c "failback"
```

In vCLI, execute as follows;

```
> esxcli --server=(host name or IP address of ESX host) storage nmp satp generic pathconfig
set -p (runtime name of a path) -c "failback"
```

(2) Rollback Command

Re-configure the path for I/O to the specified device (logical disk) on the preferred controller set by the disk array.

```
~ # esxcli storage nmp satp generic deviceconfig set -d (device name) -c "rollback"
```

In vCLI, execute as follows;

```
> esxcli --server=(host name or IP address of ESX host) storage nmp satp generic deviceconfig
set -d (device name) -c "rollback"
```

Appendix B History

PathManager		Classification	Changes
Media Ver.	Minor Ver.		
1.2	1.2.1	Bug fix	* A system might stop or might not start up correctly, when NEC Storage M300, M500, M700 or M5000 is connected.
	1.2.0	Enhancement	* supports NEC Storage M5000 * supports VMware ESXi 5.5 * supports the alert function which cooperated with NEC ESMPRO on the linux syslog server
		Important notice of the compatibility	* The output format of the syslog message was changed.
	1.1.3	Bug fix	Same as Minor Ver.1.2.1.
	1.1.2	-	Same as Media Ver.1.1.
1.1	1.1.2	Bug fixes	The following issues are fixed. * Kernel panic rarely occurs on the VMware host OS. * An active path may transfer to the dead state and does not recover any more. * When "Reservation Conflict" occurred by software which uses "SCSI-2 RESERVATION", a path may become a failure state transiently. * If a disk array which has 4 controllers and 56 or more storage port is used, the I/O performance may fall because of using all the active paths including the non-current owner controllers.
	1.1.1	Enhancement	* supports NEC Storage A5000 Open Volume
	1.1.0	Enhancement	* supports VMware ESXi 5.1. * supports NEC Storage connected by SAS-HBA.
1.0	1.0.0	Enhancement	* supports VMware ESXi 5.0. * supports NEC Storage connected by FC-HBA or iSCSI.

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